International Conference on Renewable Energies and Power Quality (ICREPQ'16)
Malaga (Spain), 4th to 6th April, 2017
Renewable Energy and Power Quality Journal (RE&PQJ)
ISSN 2172-038 X, No.15 April 2017

Production under feed-in tariffs in Portugal

P. Lourenço[1] and C. Almeida[1]

[1] EDP Serviço Universal, SA
Direção Compra de Energia
Av. Urbano Duarte, 100 – 3030-215 Coimbra (Portugal)
Phone number: +351 239 002 000, e-mail: **pedro.lourenco@edp.pt**, **cristina.almeida@edp.pt**

Abstract. In Portugal, over the last two and a half decades, high focus on the promotion of renewable energies has been set, particularly through power plants with feed-in tariffs, which has increased the use of internal energy resources and has stimulated the reduction of the country's energy dependence.
During this process, the development of related legislation and the dynamism of the sector, with the introduction of incentives which prompted the investment and promoted the maturation of new technologies, has been essential. Gradually, in conjunction with the acquired experience and knowledge, a sustained growth of renewables energies has been possible. Moreover, it put forward scientific research in this area and established attractive revenues in this market, which allowed the reinforcement of the existing energy cluster in Portugal. As a result of this energy policy, the purchase of energy feed-in tariffs producers has reached quite significant values. At the end of 2015, the installed capacity was about 7 900 MVA, which corresponds to the acquisition of 20TWh.

Key words

Renewables, Cogeneration, Small production, Feed-in tariffs.

1. Introduction

Energy production in a country like Portugal, which still imports most of its energy for consumption, is increasingly sensitive. In this context, renewable energy is a key asset, structural and strategically, for sustainable development in the economic, environmental and social aspects.
Bearing in mind the need to import non-renewable energy sources, renewable energy production plays an import role, allowing to ensure the energy supply of the country, enabling energy autonomy and the development of a more balanced and sustainable energy mix.
The continuous rise of the awareness about climate change, in particular the limitation of greenhouse gas effects (GHG), allowed renewable energy sustained growth based on the rationalization of natural and endogenous resources.
It shall be pointed out that renewable energy, the majority of power plants with feed-in tariffs have an intermittent feature, depending on weather conditions, comparing with cogeneration energy production. Due to this, the electrical system requires the existence of power plants in the ordinary regime, which usually are market quoted, to ensure the necessary backup power. It must be ensured that production of hydro and thermal power plants can face the energy demand, when there is fluctuation within the plants with feed-in tariffs.
In the Decree-Law 215-B/2012, of October 8, it was settled that the production with feed-in tariffs can be exercised under two separate schemes: general regime, in which producers sell the energy produced in organized markets; guaranteed compensation regime, in which the energy produced is delivered to the last resource supplier (CUR) in return for a guaranteed compensation.
Owing to the policy that has been followed in Portugal, renewable energy, including large hydro, in which the power purchase applies is performed through organized markets, have contributed significantly for the total electricity offered. Accordingly to the data provided by REN, the Transmission System Operator (TSO), renewable energy represented about 62% in 2014 and 47% in 2015.
The aim of this paper is to contribute to the discussion of this issue, with particular emphasis on the production based on feed-in tariffs. Thus, the evolution of the production with feed-in tariffs in Portugal will be described, as well as the regulatory environment, and future prospects.

2. Legislative Developments

The feed-in tariffs structure for electricity production was created by Decree-Law 189/88 of May 27. This document promoted renewable energy and encouraged the use of cogeneration processes, triggering the reduction of energy dependence of the country. Moreover, it created economic conditions for the access of small producers with efficient facilities to energy production sector. The benefit of such facilities was linked to the selling price to the consumer.
For about a decade complementary legislation was published, aiming to regulate and correct situations created by the change of the National Electricity System (SEN), including its liberalization.
However, the biggest legislatorial revolution happened in 1999 with the publication of Decree-Law 168/99, of May

18, for the production of electricity using renewable and waste processes, and Decree-Law 538/99, of December 13, for the production through cogeneration process. These documents resulted in a significant improvement of the producers' remuneration. Both were designed to meet growing environmental concerns, making it necessary to reconcile energy and environmental policies, and at the same time enabling compliance with international commitments for the limitation of greenhouse gas. Commonly, these decrees contain the tariff structure update applicable to the sale of energy produced from renewable resources and cogeneration facilities. Furthermore, the mechanisms regarding the definition of network interconnection points were simultaneously changed.

The adjustment of the compensation process was performed through a feed-in tariff structure update, creating a fixed remuneration, which represents the prevented costs in the investment in new facilities and power stations, the variable remuneration that considers the prevented costs of operation and maintenance and the environmental remuneration, which values non-emitted CHG. We state that after the legislative change major growth of capacity installed regarding feed-in tariffs power plants took place, as shown in Fig. 1 and Fig. 2.

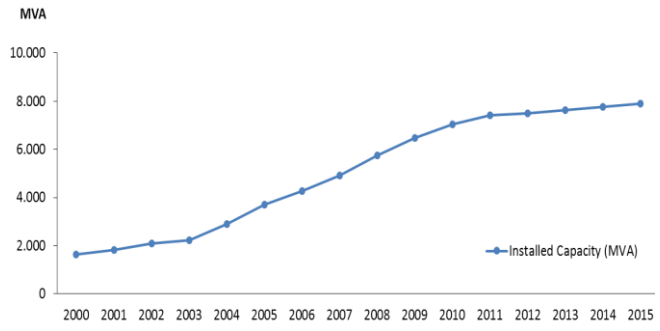

Fig. 1. Evolution of installed capacity regarding production with feed-in tariffs in Portugal.
Source: EDP Serviço Universal

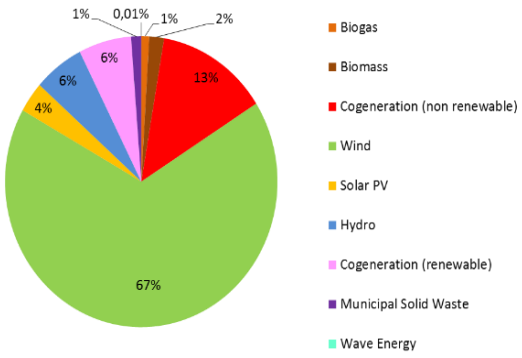

Fig. 2. Percentage of power capacity by technology in Portugal in 2015
Source: EDP Serviço Universal

A. Renewables with feed-in tariffs

In 2001, the process of remuneration of renewable installations was once again reviewed through Decree-Law 339-C/2001 of December 29. The introduction of a new parameter, Z, within the compensation calculation method, established a differentiated payment for technology and regime of exploitation, providing more favourable conditions for potential emerging technologies in the medium and long term, such as wind, solar photovoltaic and wave technologies. The attractiveness of the renewable business was so pronounced that originated, mainly in wind energy, a significant growth of the sector.

Empowered by the evolution and maturity of technologies Decree-Law 33-A/2005 of February 16 was published, limiting some feed-in tariffs, reflecting the new existing reality, and establishing measures to recover the investment. After the investment recovery period, the energy will be remunerated at market value (OMEL) and the revenue from the sale of green certificates.

Decree-Law 225/2007 of May 31 was published based on the need to encourage alternative forms of energy production from renewable sources. The supported technologies were biogas, forest biomass, solar photovoltaic microgeneration installed in IPSS (social solidarity institutions), solar and waves. Once more, the legislation for the feed-in tariffs was updated, creating power allocation tenders which promoted discounts to the feed-in tariffs for power plants whose technology was more developed.

Additional periods to the feed-in tariffs were also granted in return for a reduction in the tariffs or a payment to SEN compensation from the wind farms producers, under Decree-Law 35/2013, of 28 February and Directive ERSE 9/2013 of 26 June.

B. Cogeneration with feed-in tariffs

The main legislation on cogeneration was reviewed in 2001 with the publication of Decree-Law 313/2001, of December 10, that introduced some adjustments in order to provide a desirable development. As a complement to the regulation mentioned previously, four additional ordinances were published. Those ordinances subdivided the remuneration for power plants with a capacity higher than 10 MW, for power plants using natural gas or fuel, and for those ones using more than 50% of renewable resources. Apart from this segmentation, the remuneration structure followed the similar philosophy.

The publication of European guidelines made the adaption of the cogeneration activity necessary. Thus, Decree-Law 23/2010, of March 25, came to promote high-efficiency cogeneration, due to its potential of primary energy savings and reduction of CO2 emissions. Moreover, it contributed for reducing losses in the network due to the decentralization of electricity production, as well as for the security of supply. The Decree-Law also imposed strict and regular audits, as well as the issue of Origin Guarantees.

The remuneration structure for the special guaranteed remuneration (funded regime) has been revised and it is based on a reference tariff, which is updated every trimester. Two premiums can be added on top of the tariff, the first one for efficiency and the second one if renewable resources were used.

Regarding production not under a guaranteed regime, energy is remunerated at market price topped with a premium of participation in the market.
Once again bearing in mind the concern for energy efficiency and economic sustainability of the remuneration schemes, the Decree-Law 68-A/2015, of April 30, was published. This Decree-Law changed the remuneration structure of the general special regime dividing it into two sub modalities: the first allowing full or partial injection of the energy produced in the power grid of public service and the second one the self-consumption of that energy. The special remuneration regime began to be applied only on power plants with an installed electrical power lower than 20 MW. In addition, the producers are still able to benefit from the high efficiency and renewable premiums. [2]

C. Small Production

Microgeneration as electricity production activity began with the Decree-Law 68/2002 of March 25, which defined the details of the production of electricity at low voltage. The main objective of this legislation was self-consumption, and only the surplus was injected to the grid.
Although it did not obtain the expected impact, the Decree-Law 363/2007, of November 2, was published. The new legislation simplified substantially the licensing procedures, business relationship and billing, as well as financial stimulation for these projects.
The power connection for microgeneration could not exceed 5.75 kW and 11.04 kW for condominiums. In terms of remuneration two systems were created: general and funded. The funded regime could only be applied to installations that used renewable sources and fulfilled some complementary criteria, for instance, not exceeding 3.68 kW of power connection. The general regime englobes all other installations. Due to the success achieved, the previous legislation was republished, adapting it to the new reality, adjusting the remuneration and implementing new energy efficiency measures by Decree-Law 118-A/2010, of October 25.
Replicating the example of microgeneration, it was published Decree-Law 34/2011, for minigeneration for connecting power up to 250 kW. Both remuneration schemes were maintained, and access to funded regime forced compliance to certain requirements, including conducting an energy audit.
In order to overcome practical and operational difficulties between stakeholders in the energy procurement process, Decree-Law 25/2013, of February 10 was published. Nevertheless, in the following year the legislation about microgeneration and minigeneration was abolished with the publication of Decree-Law 153/2014, of 20 October.
The new law kept the general outline presented above, and reintroduced self-consumption. Thus, small production started to benefit from a single legal framework. These kind of units began to be known as Unit of Small Production (UPP) and Production Unit for Self-Consumption (UPAC), depending on its features. [1]

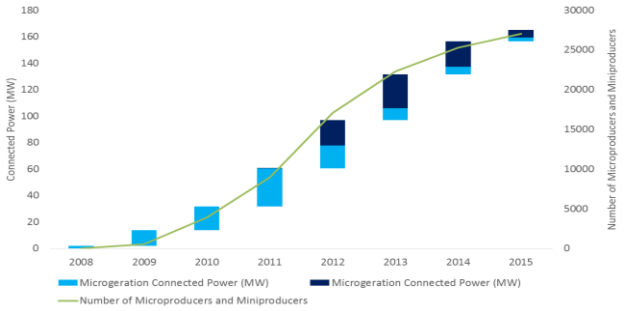

Fig. 3. Evolution of Microgeneration and Minigeneration in Portugal
Source: EDP Serviço Universal

3. Evolution of production with feed-in tariffs in Portugal

During the last 25 years we have observed many changes in the electricity sector, particularly for producers with feed-in tariffs. Due to environmental concerns and security of energy supply, Portugal has improved its use of efficient technologies and installation of electrical power generation solutions using renewable and indigenous resources. This development resulted in the sustained growth of renewable energy, enabling the creation of wealth and the promotion of scientific research in this area, gradually consolidating the existing energetic cluster in Portugal.
The evolution of the legislation allowed reaching a substantial value of energy purchase to producers with feed-in tariffs. In 2015, about 20 000 GWh was acquired (Fig. 4), representing about 2 000 M€ of billings (Fig. 5).

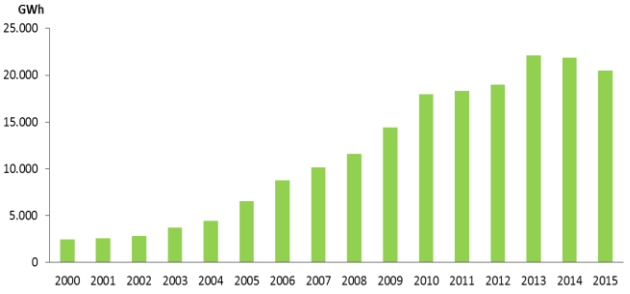

Fig. 4. Evolution of energy produced through feed-in tariffs in Portugal
Source: EDP Serviço Universal

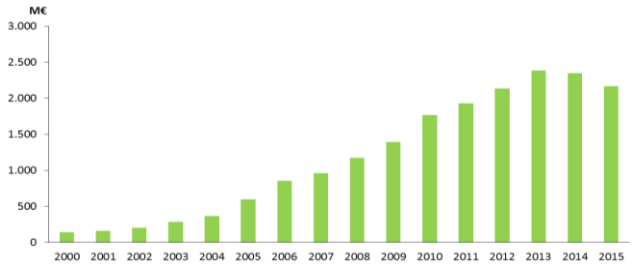

Fig. 5. Evolution of feed-in tariffs production invoicing in Portugal
Source: EDP Serviço Universal

As mentioned above, the legislative changes have generated different feed-in tariffs. Thus, there have been different average prices for each technology (Fig. 6.).

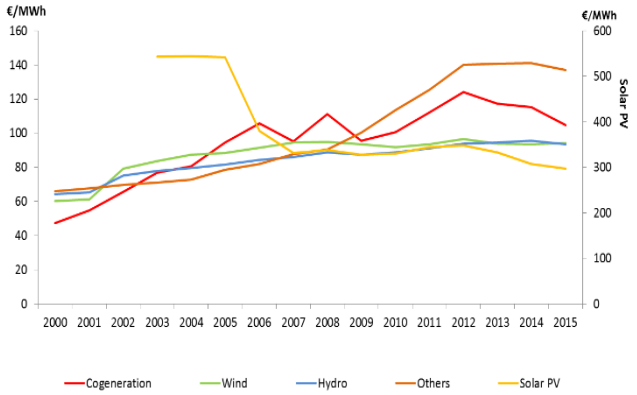

Fig. 6. Evolution of energy average acquisition prices to producers with feed-in tariffs in Portugal
Source: EDP Serviço Universal

Energy coming from feed-in tariffs in 2015 represented 42% of total national consumption. Between 2011 and 2015 this percentage has varied between 36% and 45% of total national consumption (Fig. 7).

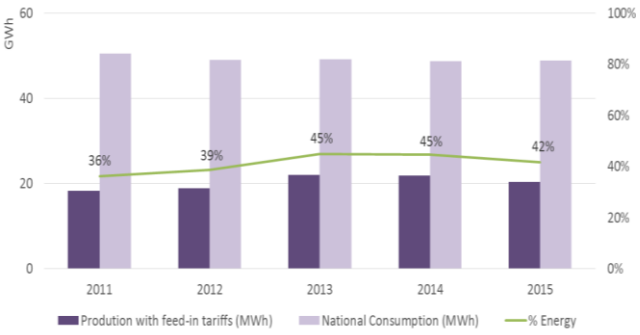

Fig. 7. Energy contribution from producers with feed-in tariffs for supplying the consumption in Portugal
Source: EDP Serviço Universal / Redes Energéticas Nacionais

Over the years, the activities of purchasing and invoicing of energy produced by feed-in tariffs have been performed by various entities. Since 2007, a last resort supplier to perform these activities was created.
Currently, the last resource supplier controls all invoices of energy from around 1 000 producers with feed-in tariffs and around 28 000 small producers. This portfolio of producers, in conjunction with significant production and billing volumes, requires a high degree of accuracy and transparency, involving the use of robust, auditable and reliable computer systems that ensure quality in reporting information. Thus, a powerful and consistent application called *GPCE - Gestão de Produtores e de Compra de Energia* (Fig. 8) was built. It is within this application that all the records, conferences and reporting of information concerning production with feed-in tariffs are made. It is also shared with the distribution system operator (DSO) and it has implemented all economic models necessary for billing since 1988. [2]
In 2011, it was developed an automatic invoicing mechanism for the producers with feed-in tariffs that led an important improvement, which brought a major operational benefits. Due to its simplicity and reliability it had a high level of acceptance by producers. This allowed, in 2015, that in a total of 12 000 registered invoices, about 75% were recorded automatically.
For small producers, due to the relationship with consumption facilities, a specific module within SAP ISU commercial system was developed. The type of operations carried out in this module are similar to the producers with feed-in tariffs in the GPCE application. To highlight these operations, this resource automatically issues the invoices for about 28 000 small producers each month.

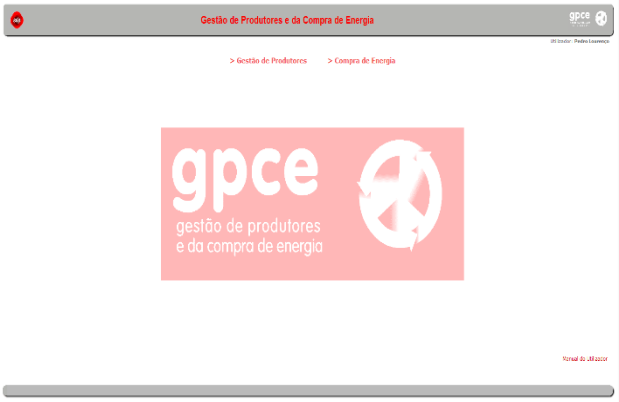

Fig. 8. Menu from GPCE - Gestão de Produtores e de Compra de Energia application
Source: EDP Serviço Universal

4. Conclusion

During the evolution of the sector we have been observing several stages. In the first one, we observed the concern to create the legal and technical conditions for the appearance of the producers with feed-in tariffs. In the second period, there was a need to promote the renewable sector through the allocation of feed-in tariffs, which clearly encouraged investment and increased the maturation of technologies, thus fulfilling international commitments. In the third stage, the current one, we have seen the progression of investment in more mature technologies and the promotion of technologies in less advanced stages of maturity.
The reintroduction of self-consumption and the small production will bring some interesting challenges, particularly for smart grids. These developments will prevent or postpone new investments and lead to reduced losses in the networks, because of the proximity between the production facilities and consumption.
EDP Serviço Universal, as the last resource supplier, is responsible for acquiring the energy with feed-in tariffs and will continue to play a key role in the implementation of policies for the sector, through continuous monitoring and an effective response to all processes resulting from legislative changes.

References

[1] Pedro Lourenço, Pedro Sá Furtado, "*Micro-generation and Mini-generation – Sustainable production and efficient use of electrical energy in buildings*", 40th IAHS World Congress on Housing, Funchal, 2014

[2] Antonio Brito, Luís Neves, "*The feed-in tariffs structure of renewable and cogeneration energy in Portugal*", 13º Congresso Luso Espanhol de Engenharia Eletrotécnica, Valência, 2013